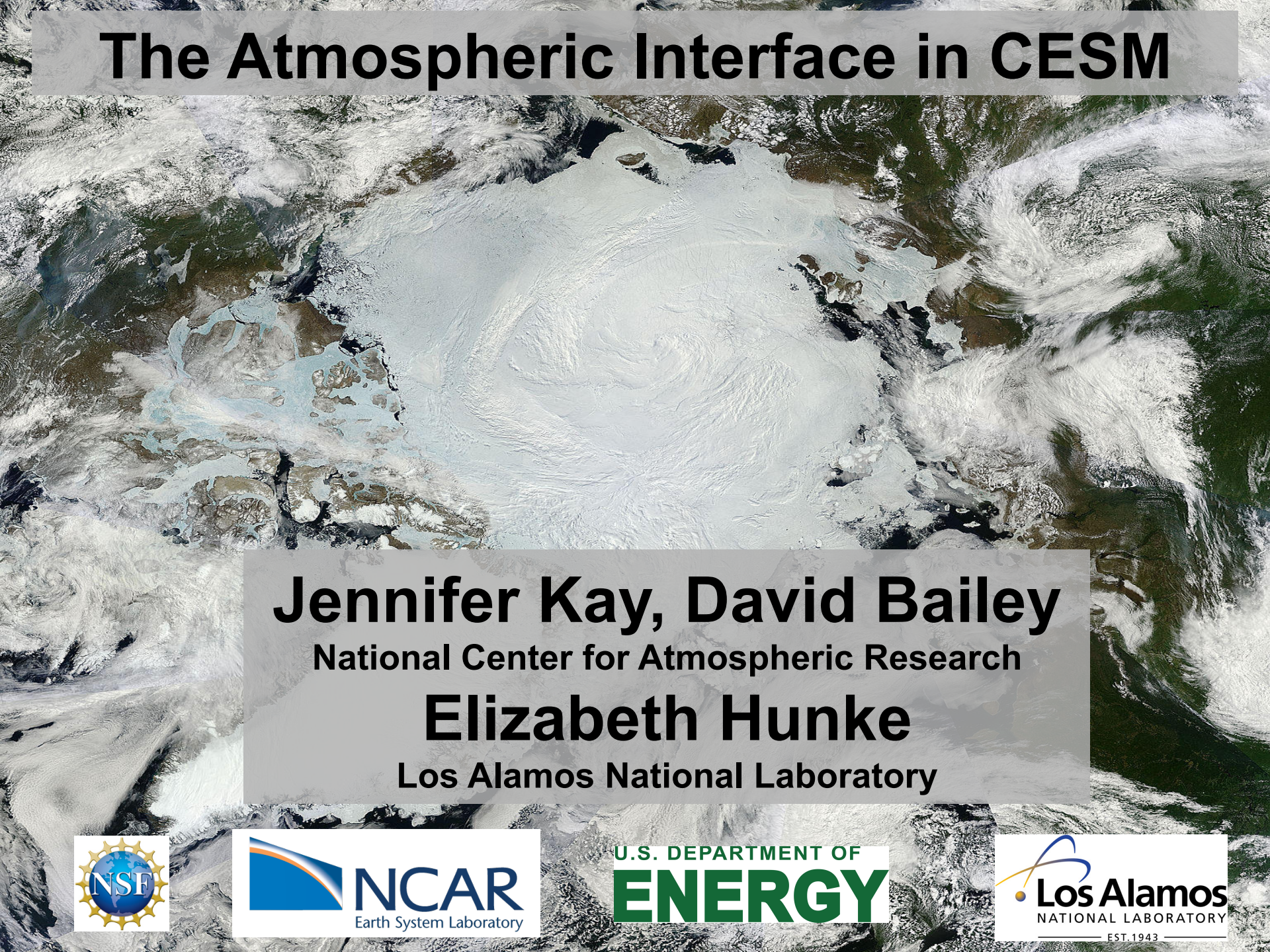
The Atmospheric Interface in CESM



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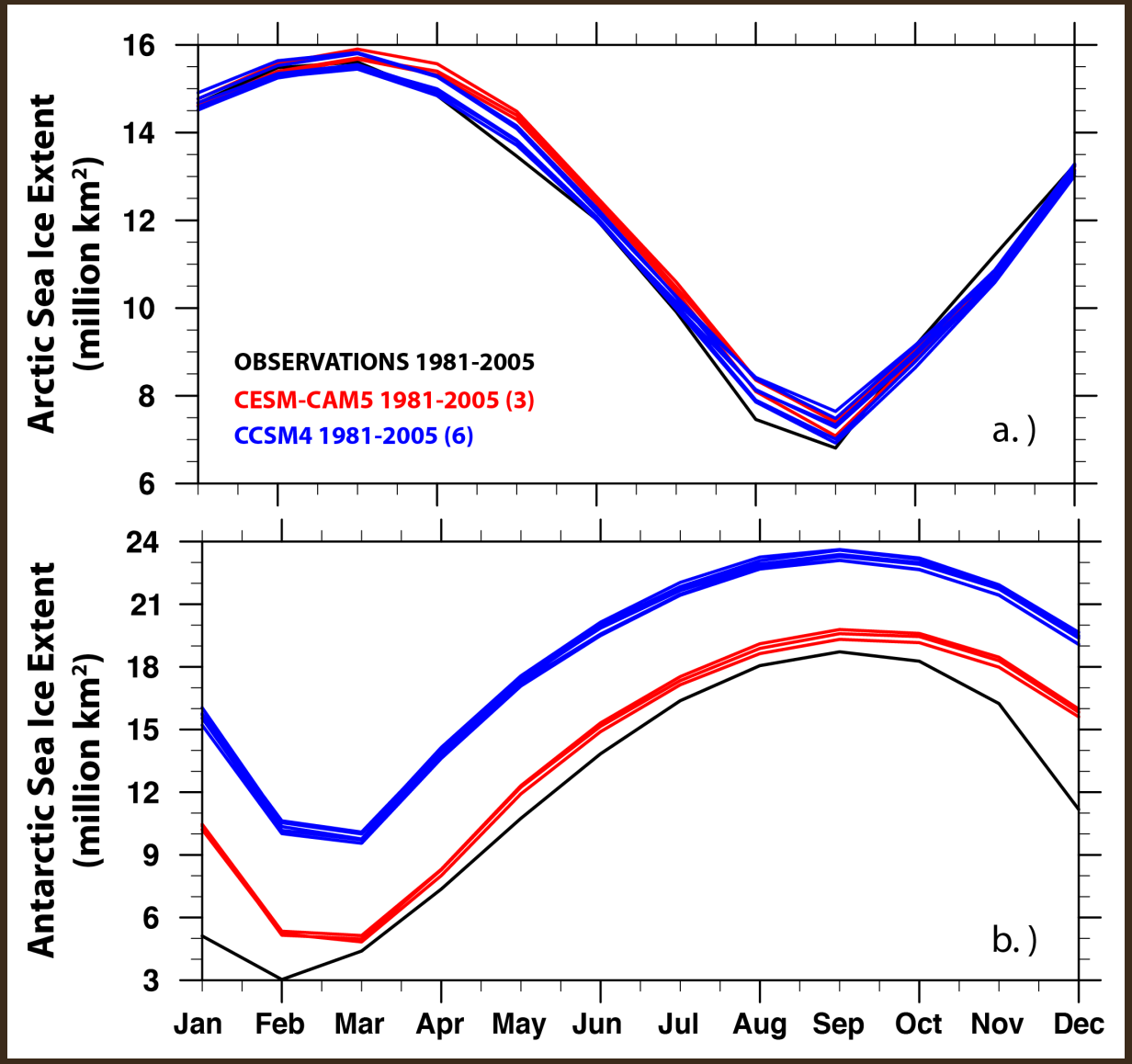
Atmospheric Model (CAM) Physics

	CAM5 (Neale et al, 2011a) Released in June 2010, 30 vertical levels	**CAM4 (Neale et al, 2011b) Released in April 2010, 26 vertical levels**
Radiation	RRTMG (Iacono et al. 2008)	CAMRT (Collins et al. 2001)
Shallow Convection	Mass flux scheme with CIN closure (Park and Bretherton 2009)	3-level adjustment of moist static energy (Hack 1994)
Deep Convection	Bulk mass flux with CAPE closure (Neale et al. 2008)	Bulk mass flux with CAPE closure (Neale et al. 2008)
Planetary boundary layer and turbulence	Moist turbulence scheme based on diagnostic TKE (Bretherton and Park 2009)	Dry turbulence scheme based on specified K profile (Holtslag and Boville 1993)
Cloud microphysics and macrophysics	Prognostic double moment microphysics (Morrison and Gettelman 2008) with ice supersaturation (Gettelman et al 2010), diagnostic precipitation at each model level, and diagnostic cloud fraction scheme	Prognostic single moment microphysics, diagnostic precipitation at surface, and diagnostic cloud fraction (Rasch and Kristjansson 1998)
Aerosols	Modal aerosol model (Liu et al. 2011)	Bulk aerosol model

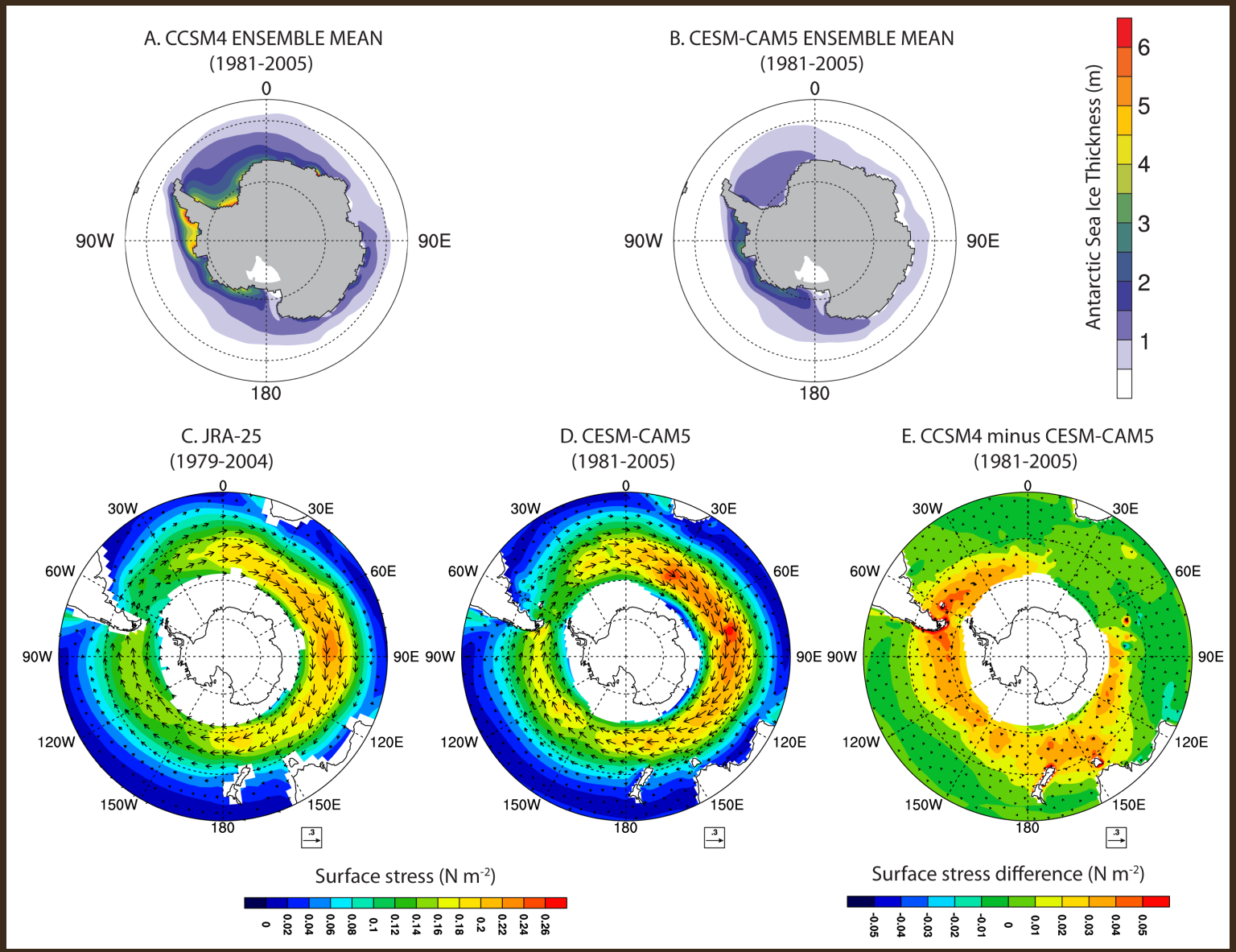
Improved CAM physics have had a large influence on CESM simulations in the polar regions!

Late 20th century sea ice extent



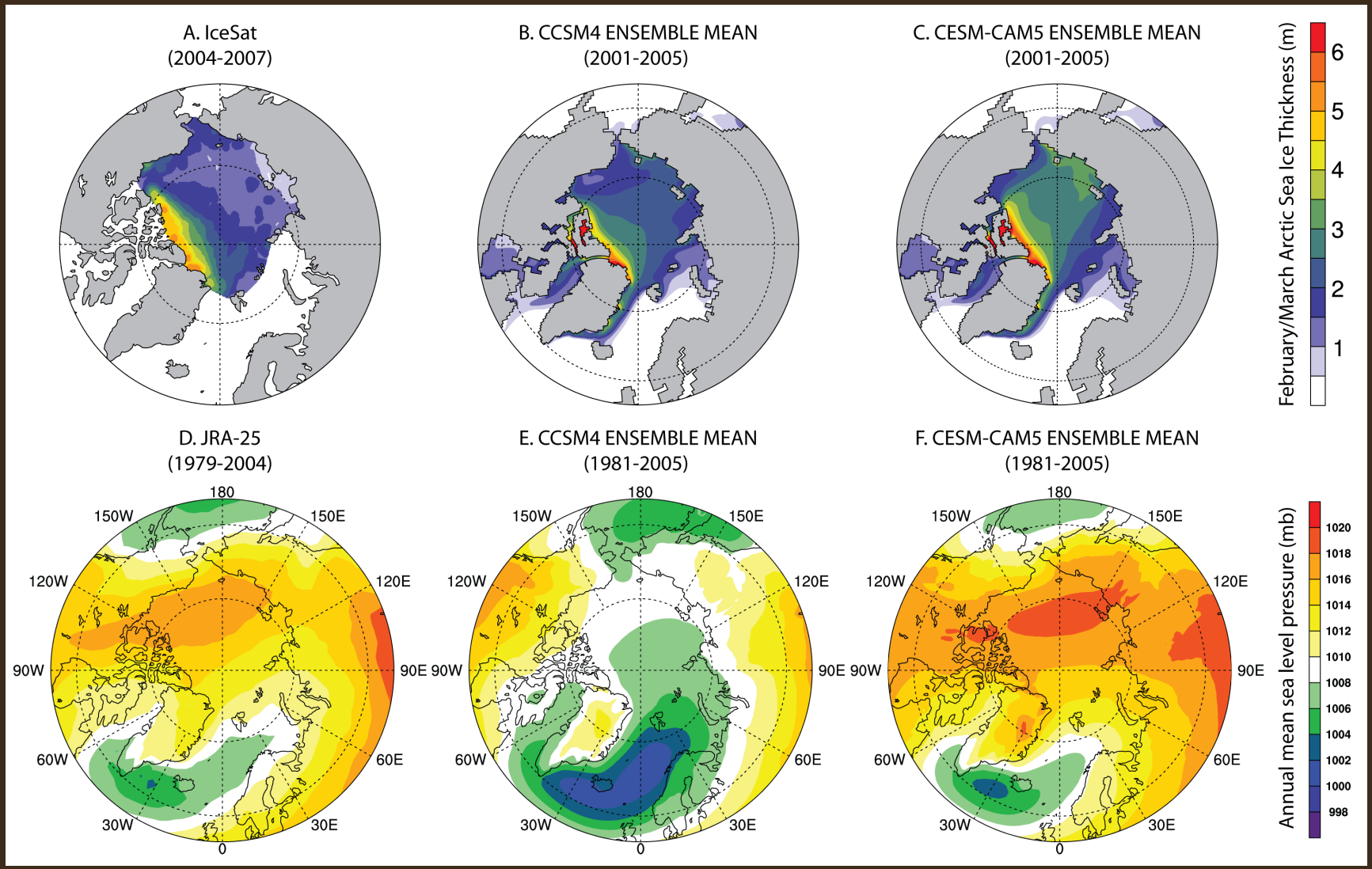
Neale et al. J. Climate (in prep)

Antarctic Sea Ice in CESM



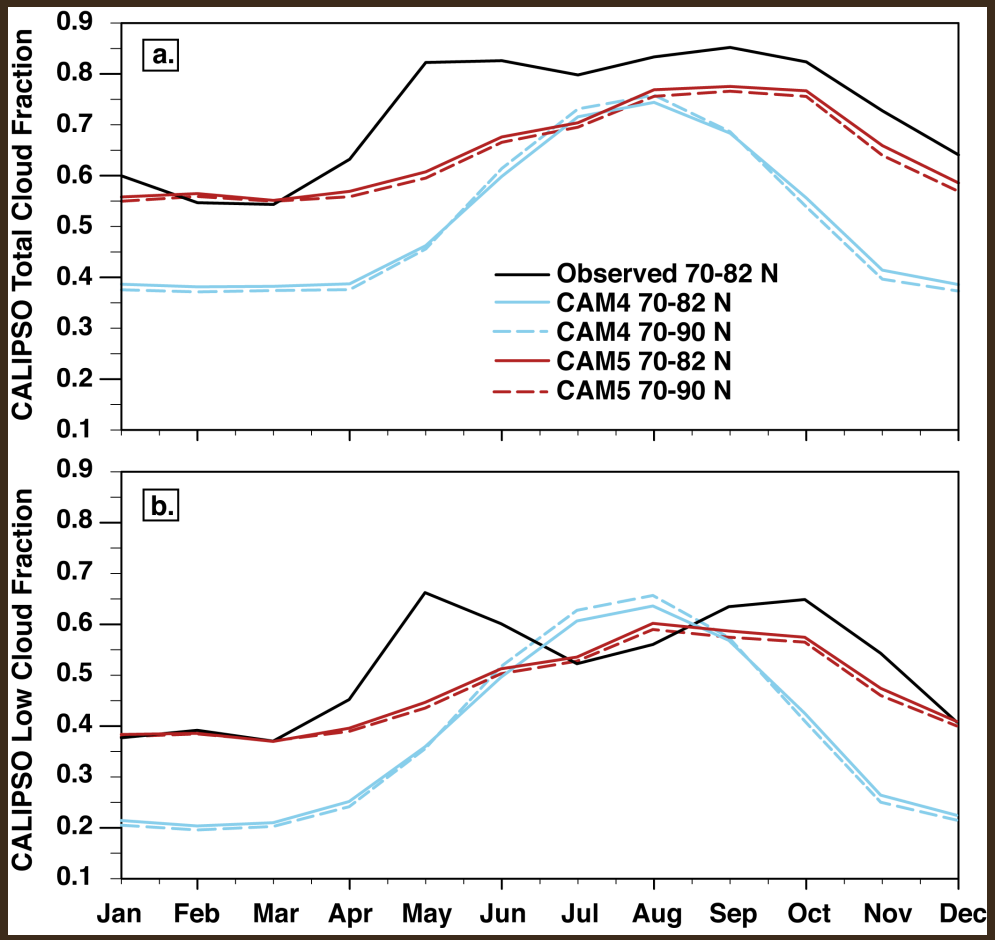
Neale et al. J. Climate (in prep)

CESM Arctic sea ice and atmospheric circulation

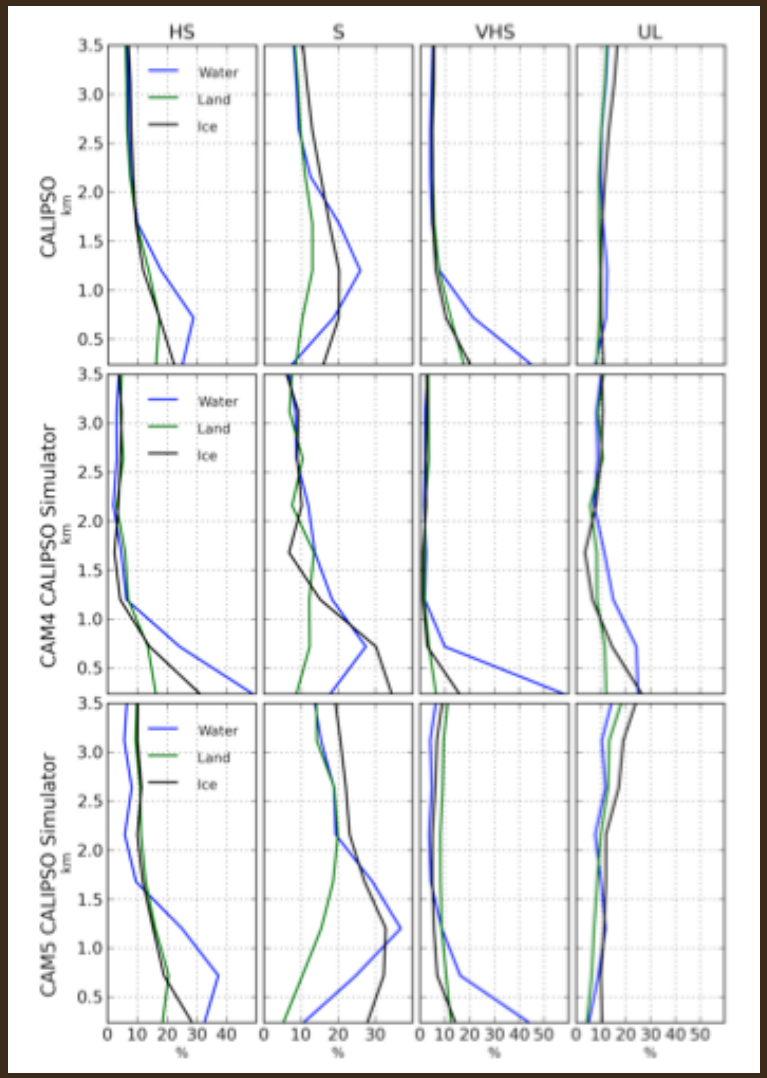


Neale et al. J. Climate (in prep)

COSP-enabled Arctic cloud fraction comparisons show improvement from CAM4 to CAM5



Kay, Hillman, Klein, Zhang, Medeiros, Gettelman, Pincus, Eaton, Boyle, Marchand and Ackerman, *J. Climate CESM Special Issue (2012)*

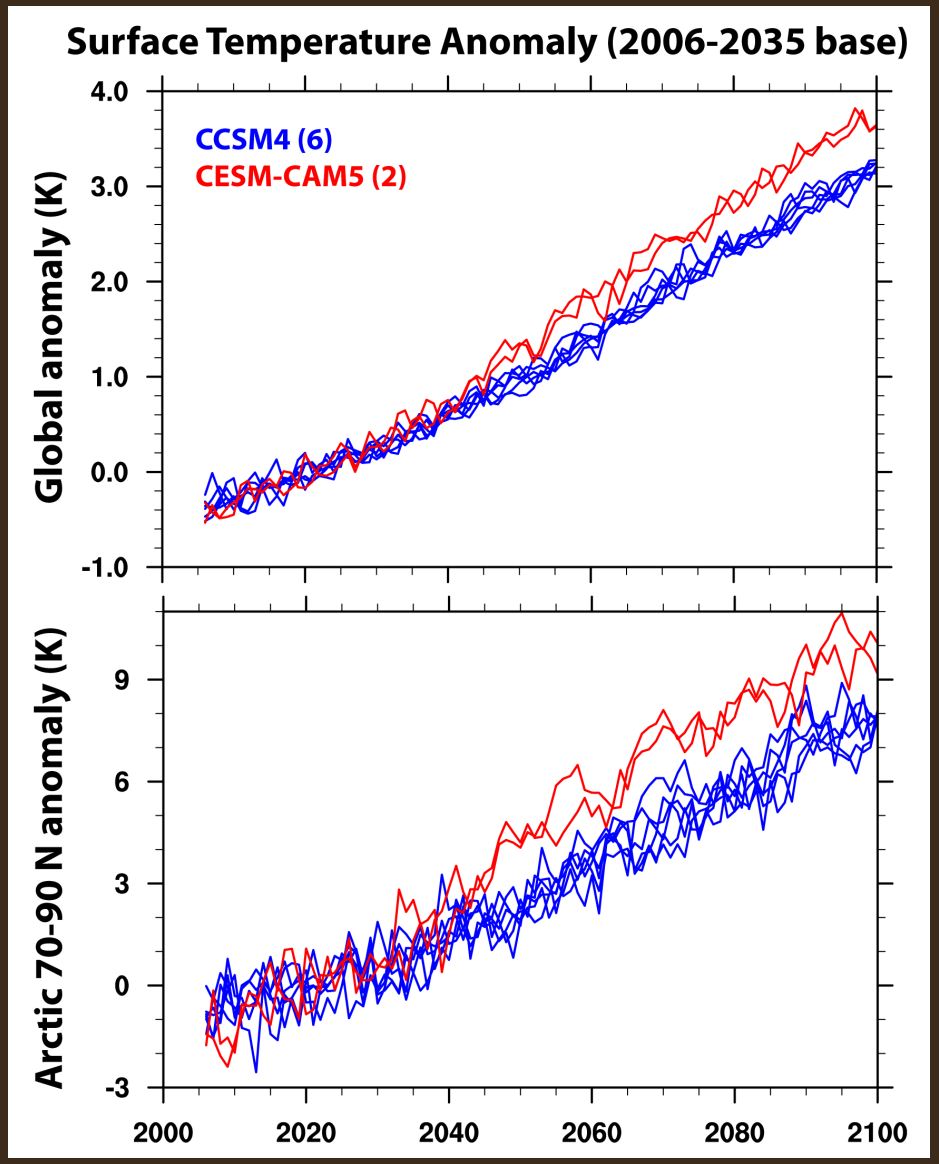


Barton et al., JGR (in press)

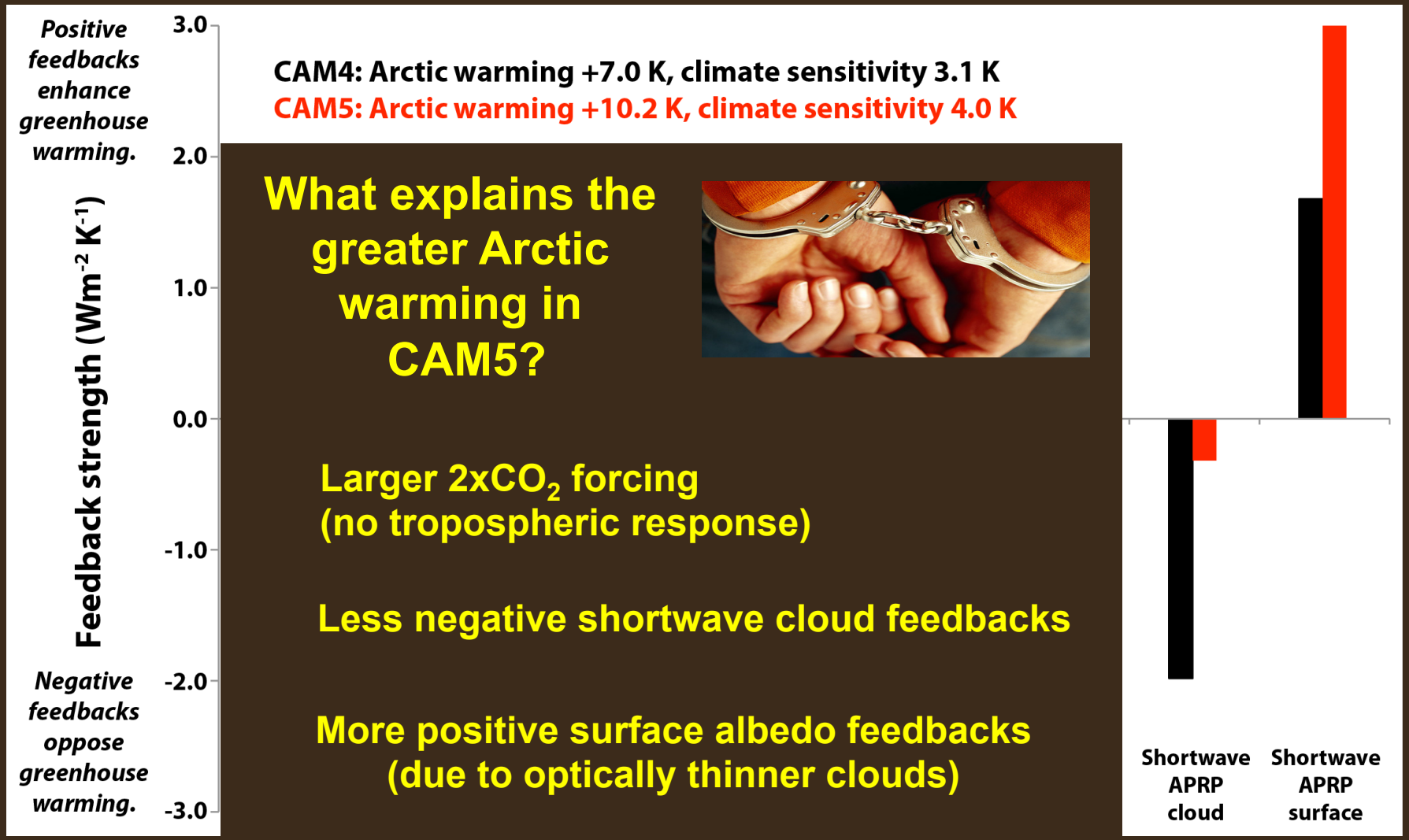
CESM 21st century surface warming (RCP8.5)

CESM-CAM5 warms more than CCSM4 by the mid-late 21st century, both globally and in the Arctic.

(RCP8.5 similar to 2xCO_2)



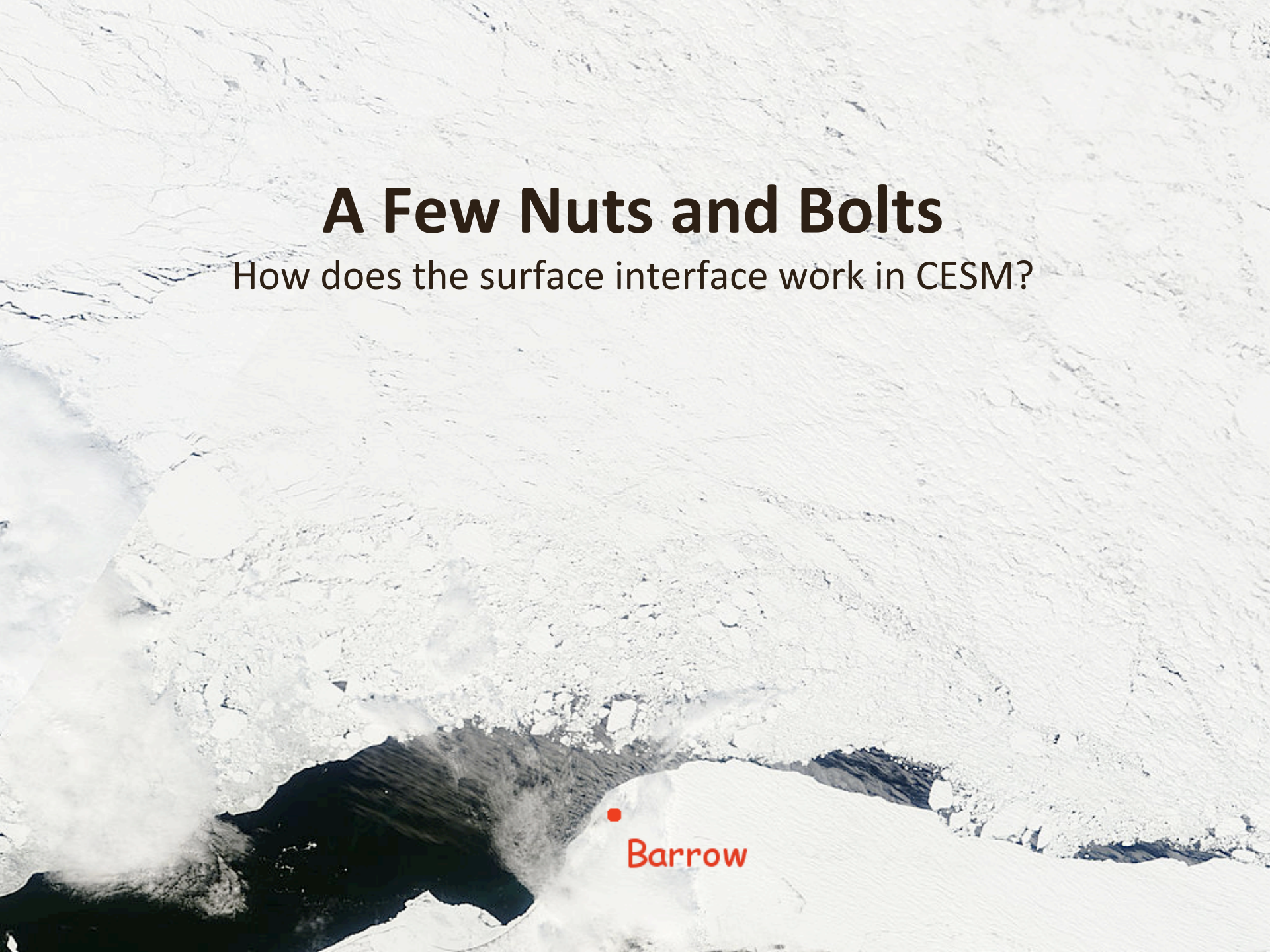
Equilibrium Arctic response to 2xCO_2



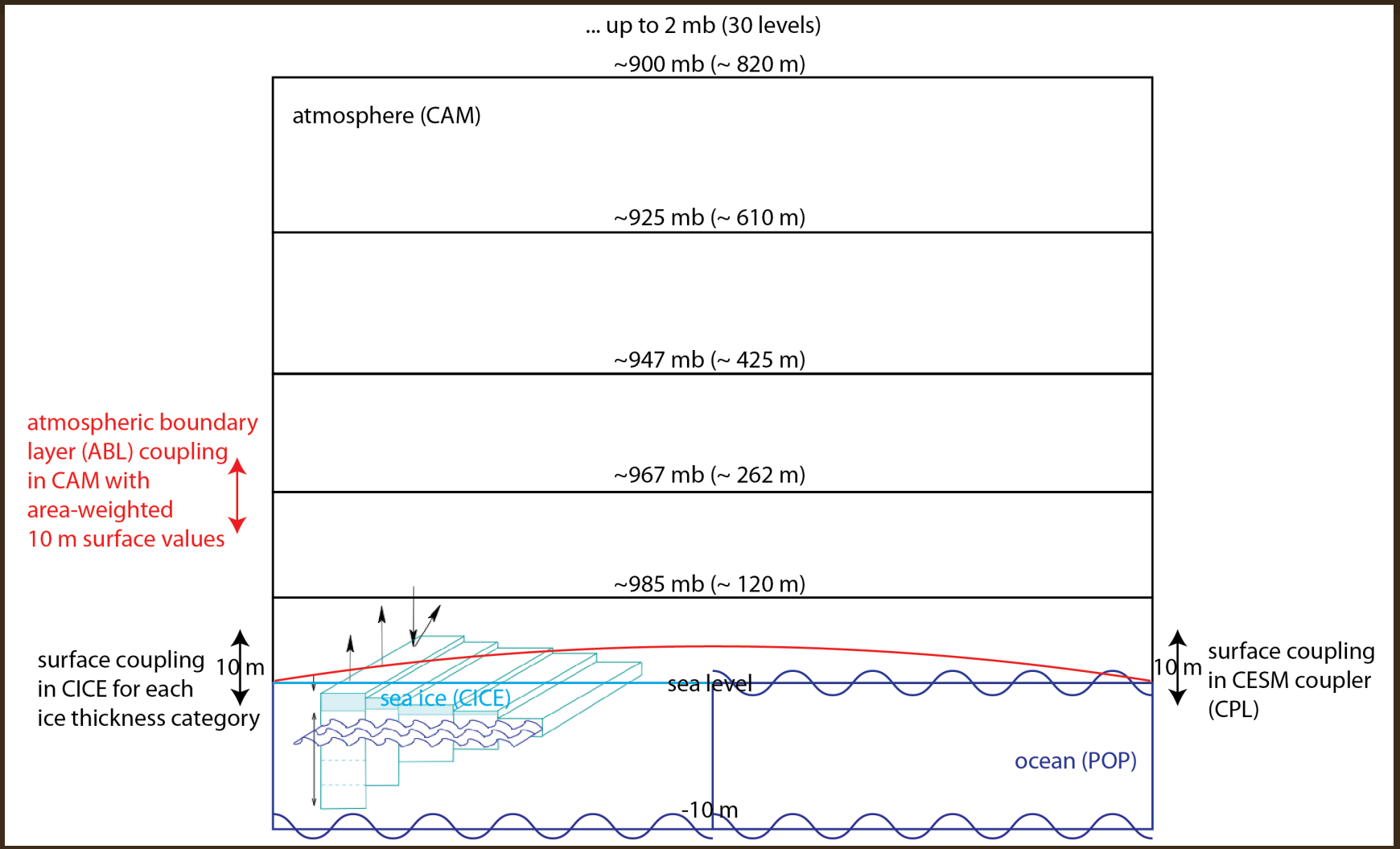
Kay, Holland, Bitz, Blanchard-Wrigglesworth, Gettelman, Conley, and Bailey 2012, J. Climate CESM Special Issue

A Few Nuts and Bolts

How does the surface interface work in CESM?



A CESM column at the surface interface



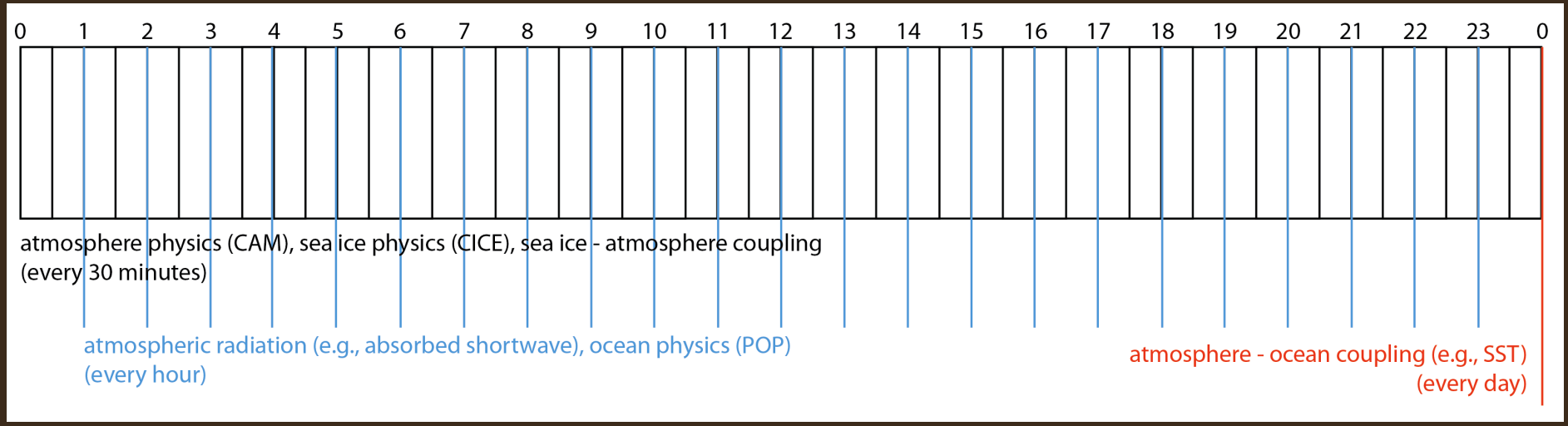
Which fields are coupled?

CAM➔CICE
Temperature, humidity, winds, radiation, precipitation, aerosols…
(z, ptem, tbot, shum, dens, sw components, lw, rain, snow)

CICE➔CAM
Surface albedo, surface fluxes and stresses
(ifrac, tsrf, albedo components, u10, tref, qref, snowh (last four are diagnostics for history), tau_ai, flat, fsens, flwout, evap, fswabs)

CAM➔➔POP
Surface calculations done in the coupler

A day at the surface interface in CESM



What is absent in the CESM framework?

What are the most critical resolution/coupling issues for credible climate simulations?

Discuss.